

J. W. Salter

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On the Lowest Fossiliferous Beds of North Wales.

By J. W. SALTER, F.G.S., of the Geological Survey of Great Britain.

The great interest always attaching to the search for the oldest types of animal life, has lately been revived by the zealous researches of M. Barrande of Prague, who has discovered and announced in various communications*, a succession of faunas in the Silurian region of that country. The earliest fauna is marked by the presence of peculiar genera of Trilobites, not found in any of the succeeding formations. Such are in Bohemia *Paradoxides*, *Conocephalus*, *Sao*; and several other genera of the *Olenoid* type, together with species of *Agnostus*.

A rare *Orthis*, a *Pteropod*, and two *Cystideæ*, are all the other forms this naturalist has discovered, after many years of patient labour, in his region C.

The publication by Angelin in the 'Palæontologia Suecica,' of a considerable number of Trilobites, confirms these views, and shows the same genera, *Paradoxides*, *Conocephalus*, and for the most part *Agnostus*, to be confined to the lowest members A. B. of the Swedish system, and with them are the long-known species of *Olenus* and the *Graptolites* of the lower alum slates.

In 1851, M. de Barrande paid a visit to this country for the express purpose of comparing the Bohemian fossils with many unpublished forms of this country. He recognised with great pleasure that the "*Lingula flag*" (discovered by Prof. Sedgwick to form the lowest fossiliferous zone in North Wales †) was a most satisfactory equivalent of this lowest stratum C.

Lingula Flags.—As all the fossils from these strata collected by the Geological Survey have now been examined, it is thought it will prove interesting to put them upon record, previously to their fuller publication in the Memoirs of the Survey.

The beds in question are largely developed in Merionethshire and Caernarvonshire, appearing sometimes in the form of fine thin-bedded sandstones, and at others of beds of black slates interstratified with coarse sandstone and conglomerate. In Merionethshire they appear at the base of a great igneous series, described by Messrs. Jukes and Selwyn as 15,000 feet thick, and the fossil beds alternate with these volcanic strata throughout their whole extent, at least the *Lingula Davisii*, which is the characteristic fossil, is found from the base nearly to the top.

In the lower part, or the true *Lingula flags*, the *Lingula Davisii* is associated with *Olenus micrurus*, a new crustacean *Hymenocaris* hereafter mentioned, and *fucoids*: higher up no fossils have been found except the *Lingula Davisii*; and at the top, but still distinctly in the igneous series, *Lingula* still occurs, probably of the same species, but associated with an *Asaphus*, a *Calymene*, and some *Graptolites*.

For the lower part of this series, which I feel sure M. de Barrande would alone con-

* The latest, and since this paper was read, is that published in Leonhard and Bronn's Neues Jahrb. 1852, p. 257, Transl. in Quart. Geol. Journ., vol. viii. pt. 2. p. 31.

† Quart. Geol. Journ., vol. iii. p. 139 et seq.

sider as belonging to the "Etage C," may be cited the following fossils and localities :—

PLANTS.		
Species.		Localities.
<i>Chondrites</i> , — sp.	Records Mus. Pract. Geol., ined.	Carnedd Ffliast, a moun- tain 5 m. S. E. of Bangor.
<i>Cruziana semiplicata</i> , n.sp.	Salter, <i>ibid.</i>	Ditto (specimens more than a foot long, abundant).
CRUSTACEA.		
<i>Olenus micrurus</i>	Salter, Decade 2. pl. 10. of Memoirs Geol. Survey.	Dolgelly; Trawsfynydd; Tremadoc; N. W. of Llanberis.
<i>Hymenocaris vermicauda</i> , new genus.	Salter, Records Mus. Pract. Geol., ined.	Dolgelly; Tremadoc; Pont Seiont, Caernarvon?
MOLLUSCA.		
<i>Lingula Davisii</i>	M'Coy, Ann. and Mag. Nat. Hist. vol. viii. 405.	Dolgelly; Tremadoc; N.W. of Llanberis; Carnedd Ffliast; near St. Ann's Chapel, Bangor; &c.

One of the most interesting fossils is a large *Paradoxides*, probably *P. Forchhammeri*, Angelin; but most unfortunately the exact locality in North Wales has not been preserved, though there is great probability it comes from the 'Lingula Flags.'

In the higher beds, near the upper limit of the igneous series, Prof. Sedgwick and myself gathered in 1843 the following fossils.

<i>Asaphus Selwynii</i> , n. sp. .	Salter, Records Mus. Pract. Geol. ined.	Hengwrt uchaf, 4 m. N.E. of Dolgelly, a bed of slate in the volcanic ash.
<i>Calymene parvifrons</i>	Salter, Append. to Prof. M'Coy's Palæozoic Foss. Woodw. Mus. pl. 1. F. f. 7.	Tai hirion, under the trap and volcanic ash-beds of Arenig bach.
<i>Lingula Davisii</i> ?.....	M'Coy, <i>supra</i>	Tai hirion; and Llyn-y-Dy- warchen, to the west of it. The Geol. Surveyors have also found <i>Lingula</i> at Hengwrt uchaf.

Lastly, at Llanfaelrhys near Aberdaron, South Caernarvonshire, in beds which both by position and mineral character appear to be the 'Lingula Flags,' although separated by great dislocations and obscured by drift, the following fossils occur.

Asaphus Selwynii, n. sp., mentioned before.

Lingula attenuata?

——, broader species.

Didymograpsus Murchisonæ, and

Graptolites incisus? or a new species.

In all these, except the first list, some doubt may be entertained whether the strata may not more properly be classed with the second division, the 'etage D' of M. de Barrande. The genera *Asaphus* and *Calymene* certainly would indicate it. There is every reason to believe that the *Asaphus Selwynii* is the same species as one common in the lowest Llandeilo flags of Shelve in Shropshire, and as such it is considered.

Therefore, if the zoological demarcations, which are of so much value elsewhere, hold good in England, it would be proper to draw the line between the fossils which occur at the base, and those near the top of the igneous series.

Professor Phillips has described a formation of black shales occurring at the base of the Silurian series in the Malvern Hills, which is characterized only by small *Trilobites*, and these of the genera *Olenus* and *Agnostus*; they are *Olenus humilis*, Phill. Mem. Geol. Surv. vol. ii. pt. 1. p. 55. f. 4-6; *O. bisulcatus*, Ph. f. 1, 2; *O. scara-*

bæoides, Wahl. ? f. 3 (*O. spinulosus* ?, Phill.), and *Agnostus pisiformis*, Wahl. Brongn. t. 4. f. 4.

It is quite possible therefore, as suggested by M. de Barrande himself, that these shales may be identical with the black slates of Sweden, and belong to the Etage C.

It should however be observed, in conclusion, that *Agnostus* in England is generally characteristic, not of the first, but of the second zone or true Llandeilo flags; we have at least three species; also that the true position of our *Paradoxides* is not known; that, in the probable equivalent of the 'Lingula Flags' in S. Caernarvonshire, an *Asaphus*, the *Didymograpsus Murchisonæ*, and perhaps *Lingula attenuata*, occur; that the genus *Cruziana*, the fucoid described below, is characteristic of beds in Normandy*, which lie nearly in the place of our *Caradoc sandstone*; and that *Hymenocaris*, the new genus here proposed, belongs to a group of Phyllopod Crustaceans not hitherto described from strata older than the Upper Silurian. Taking all these circumstances into account, it would, I think, be premature to pronounce as to the separate and distinct character of our own lowest fossiliferous zone; and it may perhaps be necessary hereafter to modify the conclusions drawn by so able and successful an observer as M. de Barrande as to the primordial and isolated character of his earliest fossil group; it may be a local, and not a general phenomenon.

It will be borne in mind that the lowest fossiliferous zone in England and Wales is not quite the oldest known. The purple and green schists of Wicklow in Ireland contain Zoophytes or Bryozoa (*Oldhamia antiqua* and *O. radiata*, Forbes), and they have been determined to occupy a similar place with the "Llanberis slates and Harlech grits" of Prof. Sedgwick, which underlie the 'Lingula flags,' and which in Wales and Shropshire are void of fossils.

Notes on the New Forms above mentioned.

I append a short description of the new genus *Hymenocaris*, and the new species of fucoid, *Cruziana*, from the 'Lingula Flags.'

Hymenocaris, new genus.

Carapace ample, semioval, narrowed towards the front, curved downward at the sides, but not angularly bent along the dorsal line; no external eyes; antennæ? of two pairs, short and not visibly jointed; abdomen as long or longer than the carapace, of 8 [or probably 9] transverse segments,—the last with short unequal appendages.

Species 1. *Hymenocaris vermicauda*, Salter, Records Mus. Pract. Geol. ined.

There are four, and may be more appendages to the last segment; for one crushed specimen shows two of them, a short and a long one on the dorsal part of the segment, and two others toward the ventral edge; and it is impossible to say how they may have been arranged.

The number of segments to the body is also not quite certain, though nearly as above stated. One specimen shows the 8 anterior, another the 4 or 5 posterior ones and the appendages. The antennæ? too, are 3 appendages, two longer than the third, proceeding from the front of the carapace: they show no trace of joints.

The genus is evidently related to the living *Nebalia*, and differs markedly from *Ceratiocaris*, M'Coy, by the entire convex carapace, not bent along the dorsal margin. It has, too, a neck furrow running all along the posterior edge. There are no traces of eyes on the exterior of the carapace. The crust was very thin.

Localities. Tremadoc; Dolgelly; North Wales.

Cruziana, D'Orbigny. *Fræna*, Marie Rouault.

C. semiplicata, sp. nov. *C. longa*, plus pollice lata, linearis, integra, ad sulcum medianum crebriplicata, extus lævigata: plicis obliquis, simplicibus aut irregulariter furcatis, ad marginem lævem latum abruptè terminatis.

It appears to differ from all the published species, in the smooth border, against which the oblique folds terminate abruptly; they very rarely run out into it. The plaits are not always equal, and are sometimes branched and occasionally fasciculate.

Locality. Carnedd Ffliast, near Bangor, North Wales; Stiper Stones, Shropshire.

* Marie Rouault, Bull. Soc. Géol. France, vol. vii. 1850, p. 725.

On a few Genera of Irish Silurian Fossils.
By J. W. SALTER, F.G.S., of the Government School of Mines.

CRUSTACEA.

Among the many new and interesting forms of Trilobites described by Colonel Portlock in his work on Londonderry and Tyrone, a small species of *Asaphus* was recorded from the Lower Silurian of Tyrone, which he named *A. latifrons*, distinguishing it from some other species by the breadth of front included within the curve of the facial suture. The species is very remarkable for the position of the eyes, which are placed very far backward and inward, so as to be close to the base of the small and narrow glabella. This peculiarity of habit is associated with some other characters which will remove the species from *Asaphus*, to which, nevertheless, it is closely allied. It has also some relations with *Illænus*.

Stygina, new genus.

GEN. CHAR. *Body ovate and rather flattened. Head and tail large and tolerably equal, body of 9 rings. Eyes small, placed far backward and inward, near the base of the glabella, which is quite indistinct above, and much contracted below. Facial suture marginal along a wide space in front, and below the eyes curved outwards, and ending on the posterior margin. Angles of head mucronate. No rostral shield. Hypostome? Axis of body narrow. Pleuræ without a furrow. Tail smooth with a moderately long axis.*

The flattened oval form, long axis to the tail, and head spines, very much resemble *Asaphus**, from which the 9 ungrooved pleuræ effectually distinguish it. In the obliteration of the glabella, number of body-rings and course of the facial suture, it is closely allied to *Illænus*, from which its habit differs so much; but there is enough of the under side preserved to show that there was no rostral shield, an essential character of *Illænus*.

Species 1. *Head spines short. S. latifrons. Asaph. latifrons*, Portlock, Geol. Rep., Tyrone, &c. pl. 7. figs. 5, 6. *A. marginatus*, ib. f. 7.—*Locality.* Desertcreat, Tyrone, in Llandeilo flags.

Species 2? *Head spines long. S.? Murchisonæ. Ogygia Murchisonæ*, Murchison, Sil. System, pl. 25. fig. 3. *Locality.* Mount Pleasant, Caermarthen, in Llandeilo flags.

The narrow axis and the smooth extremities of this species, as well as the apparent absence of eyes in the middle of the head, render it very probable that we have here a second species of the genus. The facial suture, too, as far as it can be traced, agrees with that of *Stygina*.

The Chair of Kildare, an interesting isolated patch of Llandeilo flags, discovered by Mr. Griffith, contains in some parts of the limestone swarms of a minute Trilobite belonging to the great group of the *Olenidæ*, but referable to no published type. It will soon be figured and described in Decade 7 of the Memoirs of the Geological Survey. In the meantime the characters may be defined as follows:—

Cyphoniscus, new genus.

GEN. CHAR. *Body oval and very convex; head large and gibbous; body of 7 segments; tail minute. Head half-elliptical, the glabella occupying the greater part of it; glabella broadest in the middle, oval, and inflated, without lobes; neck-furrow distinct; cheeks bent steeply downwards, with nearly parallel sides, rather broadest below, the posterior angles square. Eye-line marginal in front for a space equal to the breadth of the glabella, then running in an oblique line down the cheek, and cutting the exterior margin very obliquely some distance in advance of the posterior angle. Eyes (minute linear?) very forward; free cheeks narrow and linear. Thorax convex, the axis prominent, and the fulcrum of the pleuræ near it. Pleuræ*

* One species of *Asaphus*, described by Portlock, *A. rectifrons*, exactly resembles our genus in the wide marginal extent of the facial suture in front, and in the want of a vertical suture on the under side. But the eyes are in the usual position, and the blunt extremities and broad obscure axis show that this species is a true *Asaphus*, though probably not of the section *Isotelus*.

deeply furrowed, their ends rounded or truncate. Tail small, the axis short of 1 segment, the *sides without furrows*.

The position of the very minute eyes is indicated by a slight indentation opposite the front of the glabella; they must have been linear and small, for there is no visible elevation or appearance of an eye-lobe. In this respect there is some difference between the form under description and the North American genus *Triarthrus*, to which it is, nevertheless, most closely allied. In both genera the eye-line takes the remarkable course above described, viz. in an oblique and almost marginal line from the front to the outer edge of the narrow cheeks, and the furrow which runs along the posterior margin of the cheeks in both genera turns upward towards the termination of the facial suture. *Triarthrus*, too, has the ends of the thorax segments rounded or square, not pointed and recurved as in other Olenoid genera. But the present genus differs in the gibbous form and inflated glabella without lobes, as well as in the fewness of the segments of the thorax, 7 instead of 15 or 16.

Species 1. *C. socialis*, n. sp. Length about a quarter of an inch. *Locality*. Chair of Kildare, in Lower Silurian.

Acidaspis, Murchison.

Of this remarkable genus, one new Irish form has to be added to the list. It was formerly (Mem. Geol. Surv., vol. ii. p. 1. pl. 9. fig. 5) considered by me the same with *A. bispinosus*, M'Coy, a species distinguished by the possession of two spines on the neck. Many species are now found to have this character. The original one, described by Prof. M'Coy, is a minute species with a remarkably inflated glabella, and a sinuated front. It is from the Chair of Kildare.

The new species, of which good specimens occur in Waterford (Lower Silurian), has a wide and somewhat depressed head, with a straight front, and the glabella lobed, and not inflated. It will be figured and described in Decade 7 of the Memoirs of the Geological Survey as *A. Jamesii*.

Æglina, Barrande. *Cyclopyge*, Corda.

This genus, proposed by Barrande to replace the name *Ægle*, which he formerly bestowed on it, exhibits the greatest proportional development of the eyes known in the group of Trilobites. They occupy the entire side of the head to the exclusion of all other parts of the cheeks, and meet in front (as in the case of many insects, especially of the male sex). In this respect *Remopleurides* of Portlock is the only genus that can be compared with it; the genus under notice, however, has the eyes greatly more developed, and with large lenses quite visible to the naked eye; few body segments, and a rounded tail. The genus must for the present be placed near *Asaphus*. Two or three species are known in Bohemia, all Lower Silurian.

A new one, *Æ. mirabilis*, has been found at Portrane, Dublin; and the same, or an allied species, in Anglesea and South Wales. It will be figured shortly in Decade 7, Mem. Geol. Survey.

Remopleuridès, Portlock.

As this has just been quoted, it may be well to say, that perfect specimens of *R. dorsospinifer*, Portlock, will also be figured with the above. The remarkable dorsal spine, detected by the discoverer of the genus, is very likely a character peculiar to the male sex, and it is more than probable that *R. Colbii* is the female of the same species. Such appendages characterize the male sex in *Spheroma*.

In the *Remopl. dorsospinifer*, the possession of this spine, on the 8th segment, is accompanied by a general narrowness of form as compared with *R. Colbii*, but besides this, there is no available means of distinction. Col. Portlock had himself suggested, that two or more of these forms might prove to be varieties of one species, and in this, after careful examination, I fully concur. Again, except in the possession of the lateral appendages (which might be expected in the mature ovigerous female), and in a still greater breadth of form, *R. laterispinifer* does not differ from the two above mentioned. And hence these three forms may be respectively regarded, as the male, and the young and mature female forms of the same species. While suggesting this as probable, and supported by general analogy among the *Crustacea* and other articulate tribes, it would not be advisable to alter the names originally given.

Cyphaspis, Burmeister,

is another example of this dorsal appendage. Several of the species that have been described show something of it when perfect. A fine series of the *C. megalops*, M'Coy, from Dudley, in the collections of Messrs. Gray and Fletcher, have in each specimen a strong spine projecting from the 6th segment, which is the same segment in which they occur in the recent *Sphæroma*.

Encrinurus punctatus, a common Trilobite, has similar spines on the 7th and 10th thorax segments. *Brontes spinifer*, Barrande, and *Sao hirsuta*, ibid, have short spines on every segment.

MOLLUSCA.

The collections in Kildare have also yielded a new and very interesting Cephalopod, of a group common in North America, but not in this country. The genus *Lituities* in America contains a group of closely-coiled species, the whorls being thicker than broad (instead of broader than wide, as usual in the genus), the siphon internal, and the septa waved backwards on the peripheral margin. They are distinguished as the genus *Trocholites*. One of these species, the *Lituities* (T.) *planorbiformis*, Conrad, was found by Prof. Sedgwick and myself at Bala, North Wales. The septa in that have but a very slight backward curvature on the outer margin. A second species, from the Chair of Kildare, is different from either of the American ones. It is easily distinguished by the great depth of the backward curvature of the septa, forming a complete sinus. It may be called

Lituities hibernicus, sp. nov.

Diameter $\frac{3}{4}$ ths of an inch, thickness nearly half an inch. Whorls 4 (or 5), their thickness much greater than the breadth. Umbilicus rather deep. The inner whorls much covered by the outer. Surface with faint lines of growth, nearly smooth. Septa rather approximate, and with a deep peripheral sinus.

Pterotheca, new genus.


I wish to propose the above name for a remarkable Pteropod mentioned in the Report of the last meeting of the Association as occurring in Canada, Ireland, and Wales. Of this beautiful fossil, originally described from a Tyrone specimen as a smooth Brachiopod, better specimens have been obtained in N. Wales, which show it to have been an animal closely allied to *Cleodora*, but distinguished from it and all allied forms now known by an extraordinary expansion of the sides or wings of the shell. The cavity for the animal is a compressed triangle, as in *Theca*, *Cleodora*, and others of the order; but the dorsal lamina is much elevated above the flat ventral one, and the sides are furnished with a wing-like expansion almost to the curved tip.

Species 1. *Pterotheca transversa*. Sides entire; ventral lamina flat. Syn. *Atrypa transversa*, Portl. Geol. Rep. p. 455: As *Cleodora transv.* Salter, Rep. Brit. Ass. 1851, p. 64.

Locality. Desertcreat, Tyrone.

Species 2. *P. corrugata*, n. sp. Sides lobed, ventral lamina somewhat keeled above.

Locality. Caernarvonshire.



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